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M. VINITHA
Nimra College of Engineering, Ibrahim Patnam., Lakshmi_vinitha@rediffmail.com

A NAGESWARA RAO
Nimra College of Engineering, Ibrahim Patnam., ANAGESWARARAO@gmail.com

M. KEDAR MALLIK
Vasireddy Venkatadri Institute of Technlogy, Nambur, mallikkedar@yahoo.co.in

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OPTIMIZATION OF SPEED PARAMETERS IN BURNISHING OF SAMPLES FABRICATED BY FUSED DEPOSITION MODELING

M. VINITHA[1], A NAGESWARA RAO[2] & M. KEDAR MALLIK[3]

[1&2]Nimra College of Engineering, Ibrahim Patnam.
[3]Vasireddy Venkatadri Institute of Technlogy, Nambur
Email: Lakshmi_vinitha@rediffmail.com, mallikkedar@yahoo.co.in

Abstract: Fused Deposition Modeling (FDM) is one of the best Rapid Prototyping Processes proved to be. Many researchers have produced a lot of work using the FDM process and many papers were published. Many researchers have concentrated on optimizing the parameters to obtain higher surface finish. Burnishing is one of the processes used to get higher surface finish on light metals. The present paper deals with the application of burnishing process on the samples fabricated with FDM. The burnishing process is applied on the samples at different speeds and the surface finish results are recorded in the present experimentation.

Key words*: Burnishing, Fused Deposition Modeling, STL, Acrylonitrile Butadiene Styrene,*

INTRODUCTION:

Fused Deposition Modeling:

FDM is a process of Rapid Prototyping in which the working material, generally plastic like Acrylonitrile Butadiene Styrene, is melt by the application of heat and deposited layer by layer on a platform so that any complex shape of the component can be fabricated.

The basic process:

Although several rapid prototyping techniques exist, all employ the same basic five-step process. The steps are:

1. Create a CAD model of the design
2. Convert the CAD model to STL format
3. Slice the STL file into thin cross-sectional layers
4. Construct the model one layer atop another
5. Clean and finish the model

The machine uses two spools of ABS plastic one of which is working material and the other is support material. The materials are fed through rollers and are heated. The material is melted before deposition. CAD models of the required shape are converted into .STL file and are fed to the machine through software like MIMICS or Magics. This software converts the .STL file into machine readable form and the total model is sliced into layers of small thickness around 0.1mm. The machine deposits the material by reading the layers one by one so that the total component can be produced.

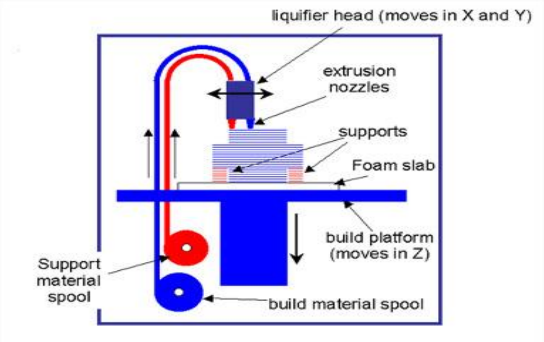

Fig. 1: FDM process

BURNISHING:

Burnishing is a surface finish process in which the surfaces of the components are subjected to loading, by which the asperities are pressed to fill the valleys, and finally the smooth surface is obtained. A ball bearing of suitable size is used to apply load on the surface. The component which is to be smoothened is held in the head stock of the lathe and rotated. Tool post of the lathe holds the burnishing tool and is fed against the rotating component, thus applying the load on it.

Finishing processes have always been important in manufacturing of all kinds of parts. A special attention is paid to surface quality, from the viewpoint of both smoothness, and physical and mechanical characteristics. Due to low roughness obtained, methods such as grinding, lapping, honing and polishing are commonly utilized for improving surface finish. Besides these methods there are other methods which improve surface characteristics through plastic deformation; these methods are referred to as ***burnishing***.

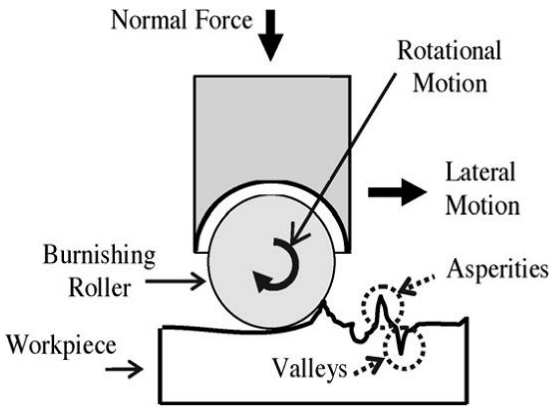

Fig. 2: Burnishing arrangement.

Burnishing is a chip-less cold-work process, which consists of plastic deformation the surface layer of the work piece through the indentation of a tool, accompanied by other simple motions that ensure machining along the desired area. The pressure generated by the indenter must exceed the yield point of the work piece's material and flattens asperities from previous machining process. These causes also strain hardening of the surface layer and induce compressive stresses into it. Finally, the result is a smooth hardened surface, with some improved mechanical properties

EXPERIMENT:

The experimentation is done in two stages, one is fabrication of the sample and the other is applying burnishing process on it. Sample preparation: Three stepped cylinders are proposed to be fabricated using ABS plastic on FDM for applying burnishing and analysis. CAD models are built using the well known Pro E software and saved as .STL files. The models are verified using Magics software to ensure that there are no flaws in the models. The models are then fed to the machine for fabrication. Before starting fabrication process, the machine well cleaned and the spools are verified whether sufficient material is available in or not. It has taken about five hours to complete the job. After removing from the machine the components are rinsed in soap water solution so that the support material can be removed from the components easily. This process is called post processing.

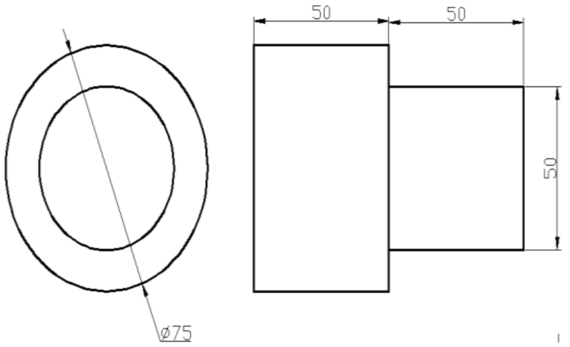

Fig. 3: Samples fabricated using FDM

APPLYING BURNISHING:

The general experimental setup is shown in the fig. 4, wherein the work piece is held in between the head stock and tail stock of the lathe machine and the burnishing tool in the tool post. Electronic dynamometer is attached o the lathe to record the loads applied on the work piece. As we have six surfaces from three samples prepared, all the surfaces are subjected to burnishing at different speed rates of the head stock spindle. The depth of penetration is selected as 0.30mm and 0.35mm. The speeds selected are 500, 1050 and 1400 rpm. Totally three speeds at two different depth of penetration are measured.

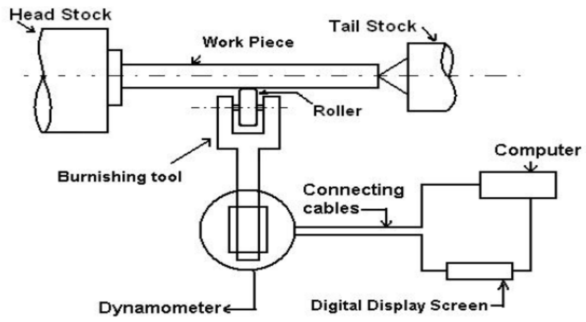

Fig. 4: Experimental setup of burnishing process.

MEASUREMENT OF SURFACE ROUGHNESS:

Inspection and assessment of surface roughness of machined work pieces can be carried out by means of different measurement techniques. These methods can be ranked into the following classes:
1. Direct measurement methods
2. Comparison based techniques
3. Non contact methods
4. On-process measurement

Direct measurement methods

Direct methods assess surface finish by means of stylus type devices. Measurements are obtained using a stylus drawn along the surface to be measured. The stylus motion perpendicular to the surface is registered. This registered profile is then used to calculate the roughness parameters. This method requires interruption of the machine process, and the sharp diamond stylus can make micro-scratches on surfaces

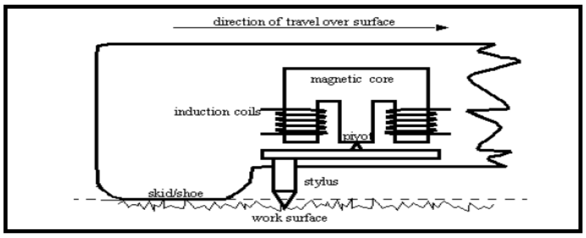

Fig. 5: Schematic diagram of surface roughness measurement

RESULTS AND DISCUSSIONS:

Reduction in the surface roughness and the increase in hardness with increase in the initial hardness of the burnished work pieces were identified. The surface roughness before burnishing was 1.28 μm. At 500 spindle speed, surface roughness value was 1.18 and 1.14 μm with depth of penetration of 0.30 and 0.35 mm respectively. As the depth of penetration was increased, more plastic deformation took place i.e. the peaks eased out which produced smoother surface and lower value. At 1050 spindle speed, the surface roughness was 0.15 and 0.14 μm with depth of penetration of 0.30 and 0.35 mm respectively. At 1400 spindle speed, lower surface roughness of 0.11, and 0.11 μm was obtained with depth of penetration

0.30 and 0.35 mm respectively. It was observed that the more depth of penetration easing out the surface and lower value. Hence it was observed that burnishing force or number of tool passes to certain limits increases the wear resistance of plaster based components under different rotating disc velocities or applied contact forces of the wear testing device. When a component is continuously moving over a surface, a plastic deformation takes place. This produces work hardening effect and this surface is hard than other surface. The surface hardness is based on the initial surface hardness of the materials to be burnished. The surface hardness is directly proportional to the applied force i.e. an increase in force increases the surface hardness. This is due to the increase of depth of penetration, increase in metal flow that leads to an increase in the amount of deformation and voids present in the metal. When the burnishing process continuously takes place for longer period of time, hardness of the disturbed layer of the surface increased significantly. Hence it was found that surface roughness improves by high spindle speeds, feed rate and depth of penetration on **Acrylonitrile butadiene styrene** (**ABS**) materials. The heat generated at the deformation zone and friction zones over heat the tool and the work piece.

CONCLUSIONS:

The test results produced significant improvement on surface roughness and surface hardness.
2. A lower surface roughness value obtained at spindle speed of 1400 with depth of penetration of 0.35 mm.
3. The surface hardness also increased as the spindle speed, feed rate and depth of penetration was increased. A higher surface hardness value obtained at 1400 spindle rotation 0.35 mm depth of penetration.
4. The more depth of penetration has increased the burnishing force on the surface and surface hardness increased.
5. This process has not produced any glassy or bright surface like other machining process due to poor machinability of the material and operating parameters can’t be increased beyond certain limit due to formation of flaw and micro crack.
6. Further study can be extended on fatigue testing after burnishing process.

REFERENCES:

[1] Representation of surface roughness in fused deposition modeling by Daekeon Ahna, Jin-Hwe Kweona, Soonman Kwonb, Jungil Songb, Seokhee Leec in Journal of Materials Processing Technology ELSEVIER

[2] Improving dimensional accuracy of Fused Deposition Modelling processed part using grey Taguchi method by Anoop Kumar Sood a, R.K. Ohdar b, S.S. Mahapatra c, in Materials and Design ELSEVIER

[3] Modeling and evaluation of curved layer fused deposition by Sarat Singamnenia, Asimava Roychoudhuryb, Olaf Diegela, Bin Huanga in Journal of Materials Processing Technology ELSEVIER

[4] Optimization of burnishing parameters and determination of select surface characteristics in engineering materials by p ravindra babu1, k ankamma2, t siva prasad3,A v s raju4 and n eswara prasad5, in Indian academy of sciences

[5] Optimization of Burnishing Process Parameters for Improved Corrosion Resistance of Aluminium and Mild Steel by R. Murali Krishna*, T.V. Subba Reddy*, Eshwara Prasad Koorapati* and N. Ravindra Reddy in International Journal of Engineering Research and Technology

[6] Effect of ball burnishing parameters on surface roughness using surface roughness methodology by dabeer, P.S. & Purohit, G.K. in APEM Advances in Production Engineering & Management

[7] Effect of Roller Burnishing on the Mechanical Behavior and Surface Quality of O1 Alloy Steel by Khalid. S. Rababa and Mayas Mohammad Al-mahasne in Research Journal of Applied Sciences, Engineering and Technology

[8] Critical Parameters Effecting the Rapid Prototyping Surface Finish by P. Vijay1,*, P. Danaiah2, K. V. D. Rajesh1 in Journal of Mechanical Engineering and Automation

[9] Fused deposition modeling of novel scaffold architectures for tissue engineering applications by Iwan Zeina, Dietmar W. Hutmacherb,*, Kim Cheng Tanc, Swee Hin Teoha in ELSEVIER

[10] Multi-criteria selection of structural adhesives to bond ABS parts obtained by rapid prototyping by Jose´ M. Arenas n, CristinaAlı´a, FernandoBlaya,AlfredoSanz in International Journal of Adhesion & Adhesives

[11] A Study of Melt Flow Analysis of an ABS-Iron Composite in Fused Deposition Modeling Process by MOSTAFA Nikzad1, SYED Hasan Masood1, IGOR Sbarski1, ANDREW Groth2 in TSINGHUA SCIENCE AND TECHNOLOGY